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The knowledge balance of the inter- and transdisciplinary Austrian Landscape Research programme

An example for the assessment of knowledge transfer processes

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The knowledge balance of the inter- and transdisciplinary Austrian Landscape Research programme

An example for the assessment of knowledge transfer processes

Karolina Begusch-Pfefferkorn

1 Austrian Landscape Research, a programme of the Austrian Ministry of Science, has created scientific foundations for the sustainable development of Austrian landscapes and regions (plus bordering regions)[1]. Landscapes and regions were to be explored from different angles; implementing the research findings was to be part of the research work. The programme was designed to make room for science open to society, for unconventional ideas, methods, and courses of action.

Knowledge balances: Tools for the assessment of research performance

2 Austrian Landscape Research (ALR) is a programme predominantly endowed with public funds. These days, the general public is increasingly casting a critical eye on the use of public funds. This requires transparency and proof of performance, in particular with respect to leverage, return flows, and market relevance. While it is obvious that the success of research devoted to the public interest cannot be measured solely by such criteria, it is certainly necessary to scrutinise the use of public funds for effectiveness and expediency and to inform the general public about the research performance. This task is tackled by the ALR knowledge balance.

3 Companies use knowledge balances to inform about achievements which – being more like a public good – cannot be assessed in terms of money. It hardly befits organisations producing knowledge to integrate knowledge into corporate accounting (shown as an expense, it would appear in the budget as a debit). This is why such companies try to identify their knowledge as (previously undervalued) intellectual capital. Many countries

are currently undertaking efforts to establish uniform guidelines for knowledge balances. International organisations, such as OECD and the European Commission, are also discussing the presentation and assessment of intangible capital values. The discussion about this new form of knowledge assessment did not stop short of the universities, applying the knowledge balance concept to identify and highlight their achievements.

4 In the German-speaking area, Austrian Research Centers Seibersdorf (ARCS) was the first enterprise to submit a knowledge balance (ARCS 1999, ARCS 2001). Their knowledge balances are reports on the results of knowledge-based activities; they use a scheme designed to achieve transparency of the knowledge flows and stocks, basing their performance presentation on the following factors:

- Human capital
- Relational capital
- Infrastructure

5 The knowledge stocks were not expressed in financial terms, but with the aid of nonmonetary criteria. The assessment of each kind of capital was based on the use of indices and the presentation of business-related and research-related results. Also shown were the efforts made by the company for developing intellectual property. The knowledge balance is meant to give a differentiated picture of the intellectual property and capital of the respective knowledge-producing enterprise.

6 The ALR knowledge balance is an attempt at presenting and assessing the performance of an extensive contract research programme. Apart from the conventional scientific achievements (publications etc.), an ALR balance should also express the specific achievements characterising inter- and transdisciplinary research programmes, such as the establishment of cross-disciplinary scientific networks or the successes in practice (Krott 2001). The ALR knowledge balance is modelled on the ARCS knowledge balance. The following criteria were selected for performance evaluation:

- Scientific gain
- Internationalisation
- Use in practice
- Additional leverage

7 The assessment of these criteria employed various indicators:

- For scientific gain:
  - Publications and activities for science
  - Qualification in the science system
  - Interdisciplinary networking
- For internationalisation:
  - Number of international cooperations
  - Number of international partners
- For use in practice:
  - Publications and activities for practice
  - Number of partners in practice
  - Qualification for practice
- For additional leverage:
  - Obtaining additional funds for the projects
  - Follow-up projects
  - Steering effects with regard to the promotional practice of various factual policies

- National and international awards
- Promotion of women
- Language work

8 Balances will supply only relative information that requires comparison to be interpreted in a meaningful way; the comparison can be made either historically or via benchmarking. Since our programme – masterminded by the Ministry of Science – is the first of its kind, there can be no historical comparison. Precursor programmes did not have any comparable balances. Moreover, any precursor programmes were primarily geared to traditional scientific gain. At best, it would be possible to compare dimension and quality of the publications. However, being based on widely differing premises of research policy, this would be a lame comparison indeed.

9 For some indicators, it was possible to draw a comparison between programme phases, thus determining whether the steering impulses of the programme management proved effective.

10 Another likewise limited option involved the comparison via international benchmarking. Programmes pursuing similar targets are, for example, the promotional programmes of the (German) Federal Ministry of Education and Research and the focal programme "Environmental Technology and Environmental Research" (SPPU) of the Swiss National Fund. As far as we know, none of these programmes has any such performance presentations.

Targets and principles of austrian landscape research

11 The reference framework of any kind of knowledge balance is made up of targets. The targets and principles of the programme are listed on the website (www.klf.at), which also specifies the steering impulses used by the programme management in trying to achieve these targets and embrace the principles involved.

Key dates of the Austrian landscape research Programme

Persons, institutions and disciplines involved

12 About 500 persons from approx. 170 institutions worked in about 80 programme modules. The programme involved almost 20 universities and over 100 non-university research institutions (extra-university research institutes, federal and state research institutes and numerous private research institutes and freelance scientists) (Table 1).

13 The first programme phase included some 350 researchers working on 30 projects (incl. accompanying modules), while the 19 projects (incl. accompanying modules) of the second programme phase involved approx. 220 persons. 95 researchers were concerned with the synthesis. Pilot projects and associated projects involved 70 researchers.

14 In the figures given below, "number of researchers" denotes the sum of persons working on the individual modules. Persons involved in several modules have multiple entries.

Table 1. Institutional origin of researchers

307	University
47	Non-university research institutions
29	Federal
5	State
334	Private
54	No affiliation specified

15 The overall programme included over 40 disciplines: biology (ecological branch) is the most strongly represented, followed by urban and regional planning and landscape ecology/ landscape planning. Numerous representatives are from the disciplines of sociology, agriculture, zoology, economics, geography, anthropology, history, geology, information and data processing, cultural technology and political science. Further disciplines include legal science, mass communication, engineering, torrent and avalanche control, architecture, biochemistry, hydrobiology and hydrology, psychology, followed by art, philosophy, technical physics, surveying, ethnology, archaeology, nutrition science, forestry and hydrology. Other disciplines represented to a minor extent are mining, soil science, chemistry, German language and literature, physics and theory of science.

Financial volume

16 The ALR financial volume amounts to approx. EUR 18 mill. Since questions and interests on the regional, state and federal levels were of equal standing within the research programme, the funds required were supplied via joint financing. The research programme was co-financed by the Federal Chancellery, the Ministry of Environment and Agriculture, the Ministry of Economics and the federal states, drawing also on international funds for research and regional promotion as well as on private sponsors.

ALR performance balance –quantitative parameters of the overall programme

Data collection for the performance balance

17 The achievements were recorded by the programme management in cooperation with the project managers. In a written survey (dispatched in August 2002), the managers of all ALR modules commissioned by then were asked to document the following achievements:

- Publications
- Activities
- Number and type of contacts with partners in practice

- International networking
- Follow-up projects

Other questions asked were about:

- the time required for intra-project networking
- the time required for external networking (exchange with persons outside the project)
- anticipated follow-up projects

The questionnaire was sent to 73 projects; 15 projects failed to respond.

18 At the time of data collection, the projects of ALR synthesis 2 were at the beginning of project work; this explains why, for the purpose of the knowledge balance, only the number of persons, institutions and disciplines involved were taken into account.

19 Project managers were also expected to compile brief reports (a maximum of five pages), giving a concise description of the outstanding achievements of the module (new findings, methodical innovations, practical successes, international reception).

Scientific gain

20 In the first place, contract research serves to provide professional support for political action; its goal is to yield directly applicable results. This is why contract research, unlike bottom-up research, cannot be evaluated solely by criteria of the science system. However, inter- and transdisciplinary projects still need to prove their worth within the science system. So to what extent have ALR projects been successful with respect to science, and what was the scientific gain achieved by them?

Publications and activities for science

21 One indicator for scientific reputation is the number of publications (for science). A total of 847 ALR papers directed to the scientific community have been written so far. They were published in the form of research reports, books and contributions to books, articles for journals and conference volumes, as well as theses, dissertations and professorial dissertations (Table 2).

22 The number of contributions in refereed journals was used as another indicator for scientific gain. To date, a total of 189 contributions in refereed journals and conference volumes have been published, as opposed to 83 in non-refereed journals. This count does not include books and contributions to books.

23 Other science-related activities – lectures, instructional courses, poster presentations, workshops, meetings with other project teams, exhibitions, research trips, hostings – were also included as indicators of scientific gain. The ALR projects documented 641 sciencerelated activities.

Table 2. Publications for science

Research reports	412
Books and contributions in books	99
Journals	136

Conference volumes	136
Theses, dissertations, professorial dissertations	64

24 After four years, the projects of the first programme phase have yielded 47% of the publications (so far). Assuming a similar figure for the other projects, we may expect some 500 additional publications.

25 The figures clearly show that the guidelines defined by the programme management since ALR2 have proved effective. Ever since ALR2, projects have been required not to invest their resources primarily into conventional research reports (addressed to the clients) but to publish the findings in media with a wide coverage that enjoy a high reputation with the selected addressees.

Qualification in the science system

26 The programme has also contributed to scientific qualification; expressed in terms of knowledge balance – to the building of human capital. The documentation includes 64 qualification papers (theses, dissertations, professorial dissertations) that resulted from the projects.

Interdisciplinary networking

27 Interdisciplinarity was one of the guiding principles of Austrian Landscape Research. To what extent did interdisciplinary networking succeed?

Disciplinary diversity: One indicator for interdisciplinary networking is the disciplinary diversity of the projects; it ranges from one discipline (predominantly in accompanying projects) to eleven.

Time required for intra-project cooperation: At the suggestion of the science controller, the time required for intra-project cooperation was also considered to be an indicator for interdisciplinary networking. The project managers were asked to estimate this time requirement. This estimate was carried out for 52 projects; the time requirement of the major part of the projects amounted to 20-30% of total project time. Translated into funds, these estimates show that some EUR 3 mill. went into efforts directed at interdisciplinary progress.

Authors' team: To some extent, interdisciplinary networking may also be measured by authors' teams. Out of a count of 435 publications for science (research reports not included), 198 were published by authors' teams. Assuming that authors' teams strengthen interdisciplinary science, the programme has made an important contribution to this cause. At the same time, this figure may be interpreted that cooperating in interdisciplinary project teams need not conflict with the qualification within one's own discipline: Over half of scientific publications are individual publications.

Internationalisation

28 From the very beginning, internationalisation has been a principle of Austrian Landscape Research. Has ALR proved successful in this field? As criteria for success, we have

established the number of international cooperations and the number of international partners.

Number of international cooperations

29 On the one hand, internationalisation means that the results of the ALR projects were incorporated into international research in various ways, while on the other hand project workers continue working in ALR projects on findings acquired in international projects. The total count of international cooperations was 152.

30 The count shows that EU research was a focus of internationalisation: submissions under the EU research framework programmes were the most frequent form of internationalisation (under the 4th and 5th framework programme: 38 submissions).

31 The 6th framework programme had new types of projects, which required the submission of Expressions of Interest: "Networks of Excellence" and "Integrated Projects".

32 A remarkable balance was delivered by the abovementioned synthesis project "Initiation of a Socioecological Network of Excellence within the Scope of the European Research Area" commissioned under ALR Synthesis 2001: The numerous networking efforts of this project resulted in various activities and submissions under the 6th EU framework programme – nine Expressions of Interest, project applications for two Specific Targeted Research Projects (STREP), for one Network of Excellence and for two Integrated Projects – as well as the participation in the building of several European research networks, e.g. within the scope of the initiative "Sustainability Geoscope". The Network of Excellence ALTER-Net was commissioned.

33 In view of this successful synthesis project, it should be mentioned that not all applicants were given a chance for developing their international partnerships under ALR Synthesis 2001. Numerous other projects for building networks and preparing the European Research Area could not be commissioned due to the withdrawal of funds by the Ministry of Science; as a result, a lot of potential for international networking of programme researchers remained untapped.

34 The degree of internationalisation of the ALR projects – i.e. the proportion of internationally cooperating projects with respect to the total figure – is high: 89% of ALR1 and 92% of ALR2 projects are involved with international research in some way or other. Many international cooperations were also implemented within the framework of synthesis projects. ALR Synthesis also had the so-called category of "practice projects", for which international cooperation was not relevant. When determining the average, these projects have a negative effect, because the proportion of projects with international cooperations – values around 60% – is distinctly below that of ALR 1 and ALR 2.

Number of international partners

35 Cooperation was most intensive with partners from Germany (60 partners), followed by the UK (33) and the Netherlands (29). Networking with the neighbouring states – Switzerland (27), Italy (19), Slovenia (18), Czech Republic (11), Slovakia (6), Hungary (1) – was also relatively intensive; there is no documented cooperation for Liechtenstein.

Use in practice

36 Along with interdisciplinarity, transdisciplinarity is the guiding principle of ALR. The term denotes scientific work with non-scientific partners sharing in the generation of knowledge (see www.klf.at). Austrian Landscape Research wants to contribute to the solution of societal problems. Principles of this research are: focus on implementation, relation to planning and relevance in practice – unusual demands to scientific programmes, to be sure. So how does implementation of research findings actually work? In ALR projects, researchers had to go beyond the boundaries of science and enter into a dialogue with society. To what extent did they prove successful?

Publications and activities for practice

37 Indicators selected for use in practice were "publications and activities for practice". By the time of conduction of the survey, the projects had yielded 374 publications for practice, while 231 activities were documented (counselling, art event, project presentations, school project, TV and radio contribution) (Table 3).

Table 3. Activities for practice

	Total
5.5 Counselling	36
5.4 Art event	13
5.3 TV/radio contribution	37
5.2 Project presentation	115
5.1 School project	30
Sum	231

38 The support through accompanying projects seems to have had a positive effect on the number of press articles: intensive media work, including empowerment of the programme researchers, resulted in 55 news items in 2001 vis-à-vis 1 to 31 at the most in the preceding years.

Partners in practice

39 The practical impact was also assessed on the basis of the number of contacts with practice. ALR was in contact with 1.250 persons from 680 extra-scientific institutions; the programme involved about 75 communities as specified below (Table 4):

Table 4: Partners' functions

Participation in workshops	459

Interview partners	226
Exchange of experience (in discussions...)	223
Cooperation (execution of partial project tasks)	135
Counselling	69
Member of an accompanying committee	68
Co-financing	60
Implementation of the project concept	41
Execution of a school project	39
Execution of an art project	31
PR work	21
Event organisation	18
Evaluation of the relevance in practice (in a hearing)	4

40 The extent of contacts was clearly increased by initiatives of the programme management. ALR1 projects had an average of 18 contacts per project, ALR2 projects – 46.

Networking time

41 The extent of time invested by the projects in external networking is regarded as another indication of cooperation intensity with practice. According to project managers' estimates, up to 50% of the entire time required was spent on transdisciplinary cooperation.

Co-financing

42 Co-financing of the partners in practice is a common indicator for the success achieved in practice. The ALR financing volume amounts to approx. EUR 18 mill., a third of which is borne by co-financers. The research programme is co-financed by other federal departments and by the states; international research funds, regional promotional funds as well as private sponsors are also drawn upon. Altogether, there were some 30 financing partners.

Qualification for practice

43 After completion of their project work, some 10% of programme researchers changed jobs, with the majority changing from the university to private institutions. Job change was regarded as an indicator that the programme had contributed to qualification for practice.

Additional leverage

44 If the research programme achieves effects exceeding the intended targets and effects, we speak of "additional leverage".

Obtaining additional resources for individual projects

45 Over and above the project budget applied for, research work in some instances benefited from funds raised as internal funds by the institutions involved. As regards ALR1 projects, we only know about the unplanned internal funds. They amount to 22% of the available budget. The dimension of this proportion is essentially due to the fact that the expenses needed for inter- and transdisciplinary work were underestimated. From the viewpoint of research as a whole, this effect must also be seen positively, since resources were invested in research by numerous institutions not exclusively or primarily active in the field of research. In this respect, however, we can detect a distinct learning effect: in ALR2, the unplanned use of internal funds dropped to 14% (Table 5).

Table 5. Unplanned internal funds

	In %	Calculated in euro
ALR1	22.2	916,597.13
ALR2	14.3	619,016.37

Complementary financing

46 Numerous ALR modules also benefited from resources from parallel projects (endowed with predominantly international funds). So-called complementary financing was estimated at approx. EUR 1.8 mill., i.e., some 10% of the total programme budget.

Follow-up projects

47 ALR projects have yielded a total of 190 follow-up projects, half of which were not financed by the Ministry of Science, while the rest are new ALR projects that were in part made possible by new clients.

Steering effects with regard to the promotional practice of various factual policies

48 The findings of several modules were explicitly used for political decisions. First and foremost, they found their way into promotional policies. Four examples are given below:

- Proposed measures from the module "MU4_1: Culture – Landscape – Development in Alpine regions" were included into the programme planning document "Target 2 New for Vorarlberg".
- The classification of running waters has been identified by the Federal Ministry of Agriculture and Forestry, Environment and Water Management as Austria's contribution to the European Water Framework Directive.

- The results of the module "IN2: Study of structural features of landscape ecology as indicators for sustainable land use" are used for intermediate evaluation of the ÖPUL2000 programme (ÖPUL = Austrian programme for the promotion of an ecologically sound and extensive agriculture protecting the natural habitat; http://www.lebensministerium.at/land/).
- The "Manual for Gender Mainstreaming in Regional Development" serves as an assessment basis for intermediate evaluation of the LEADER projects.

Promotion of women in science

49 In the second programme phase, the programme started with the promotional focus "Promotion of women in science". In the "Guide for formulating project applications, July 1999" the Ministry of Science introduced a special passage to this effect. Project applicants were required to specify:

- how many person months (in %) will be done by women
- the qualification of the latter
- for which working steps they will be deployed

50 The minimum quota was 30%: 30% of scientific work (measured in person months) demonstrably had to be done by women. If the percentage fell short of the minimum quota, applicants were permitted to give a cogent justification. The target quota was 50%. Upon achievement of the target quota it was possible to apply for an addition for a modulerelated fundamental research part to be handled by women researchers. The financing framework of an additional module was EUR 14,500 maximum.

51 The quota was designed to enhance women researchers' qualifications, which is why only scientific activities were taken into consideration. Compliance with the quota was verified and had to be documented in the intermediate reports. Thanks to the promotional focus "Promotion of women in science", the proportion of resources benefiting women scientists was increased from an average 30% to 45%. Besides, five ALR2 modules made use of the promotion of women's qualification in the form of an additional project, having reached the 50% target quota.

Language work

52 Inter- and transdisciplinary science also means new ground and insecurity with regard to communication. What kind of language is suited for inter- and transdisciplinary science? How to link scientific texts and everyday speech? Such questions were accorded a special place within the framework of Austrian Landscape Research: researchers were able to expand their scientific language competence; the aim was to create sensitivity for a concise and clear language that is not left to chance. The ALR texts created certainly deserve to be appreciated, but they also showed weak points. A want of lucidity, topicality, graphic quality; the excess of pages, the pressure to produce thick volumes, had to be reduced.

53 Language efforts went into several directions. In language seminars, held to assist programme participants, the latter worked on their own texts. Another means to help participants write clear and intelligible texts was the ALR Language Book "Language. Science. Reality. On the use of language in inter- und transdisciplinary research" – Sprache. Wissenschaft. Wirklichkeit. Zum Sprachgebrauch in inter- und transdisziplinärer Forschung

54 (Nicolini 2001).

The ALR language efforts are unique in the German-speaking scientific landscape.

International exchange of experience with other programme managements

55 The trilateral project (Germany – Austria – Switzerland) had a workshop for programme managers of inter- and transdisciplinary environmental research programmes to exchange and reflect their experiences. The German representatives were from the promotional focus "Urban ecology" (Federal Ministry of Education and Research) and the focus "Humans and global environmental changes" (German Research Foundation/ DFG), Switzerland sent the programme manager of the Environmental Focal Programme "SPPU". Apart from the programme managers of the programmes analysed, interested persons from other programmes also attended the workshop, such as the representative of the Dutch programme "Dutch National Research Programme on Global Air Pollution and Climate Change". This made it possible to exchange experiences even beyond the German-speaking area. Cooperation in this workshop laid the foundation for the bilateral call for tenders of the ALR and the promotional focus of the German Research Foundation, "Socio-ecological research"

(http://www.klf.at/german/ modules/intertrans/index.htm).

National and international awards

56 Several programme modules received international awards

- The "Krappfeld Agro-Ecological Project" and the module "MU4_1: Culture – Landscape – Development in Alpine regions" were acclaimed as "worldwide sustainability projects" by the Expo 2000. This award gained a great deal of attention as well as funds for the projects and the regions concerned.
- The accompanying module "Research in and with the Public" won a main award at the first International Transdisciplinarity Congress (Zurich, 2000).
- The ALR film "In the Beginning Was the Eye" has so far been invited to more than 40 international film festivals, such as the Cannes Film Festival (May 2003). At the Pesaro Film Festival (20–28 June 2003), it won the main award (Il Premio Cinem Avenire/Award for the Cinema of the Future).

57 Special mention should be made of two works that did not win any international award, but wide recognition and unexpectedly large interest. Both have in common that they have been circulated far beyond the field of science and the national borders.

- 2.700 copies of the book "Sprache. Wissenschaft. Wirklichkeit. Zum Sprachgebrauch in inter- und transdisziplinärer Forschung" were distributed; interest is still strong.
- 1.800 copies of the manual "Gender Mainstreaming in Regional Development" were distributed. Again, interest is strong.

ALR achievements from the viewpoint of the project managers

Brief project reports

58 23 project managers have complied with the request to compile brief reports with a concise presentation of the outstanding achievements of their module – new findings, methodical innovations, successes in practice, international recognition. These brief reports deal with the issues that the project managers regarded as important: new findings resulting from interdisciplinary cooperation; methodical innovations; successes and failures in practice; international interest; joys and problems of interdisciplinary cooperation; significance of communication work; networks and partnerships emerging during the programme, and a good deal more.

59 The brief reports cast a different light on programme achievements: the emphasis is not on figures, but on personal appraisals of the scientists involved. The brief reports highlight facets of the programme that defy quantitative presentation. They counterbalance the quantitative performance evaluation and ensure a balanced performance presentation.

Conclusions

60 The success of a programme can be measured first and foremost by the quality and originality of the findings; in the science system, this is evaluated via peer review (international assessment). Yet peer review alone is not sufficient, which is why the evaluation of the scientific quality is complemented by the quantitative evaluation of the value created by the programme (programme evaluation). Indicative benchmarks are used as criteria, without disregarding the fact that science is an innovative and creative activity that cannot be compared with automated production, and consequently must not be judged solely by the latter's criteria. One outstanding new finding is an accomplishment of far greater importance for science – and not merely for science – than a large number of ordinary publications.

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APPENDIXES

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NOTES

1. The present article is an abridged version of the publication "Begusch-Pfefferkorn, Karolina (2006): KLF-Wissensbilanz – Leistungsdarstellung des inter- und transdisziplinären Programms Kulturlandschaftsforschung. See Begusch – Pfefferkorn K., 2006, pp. 119-139 and Begusch – Pfefferkorn K., Brucker J.E., Dankl C., 2003. The article is based on the report "KLF-Wissensbilanz. Leistungsdarstellung und -bewertung des inter- und transdisziplinären Programms Kulturlandschaftsforschung" by Karolina Begusch-Pfefferkorn, Claudia Dankl

(Internationalisierung) and Judith E. Brücker (Compilation and editing of the brief descriptions); Vienna: unpublished manuscript, 2003.

ABSTRACTS

Austrian Landscape Research, a programme of the Austrian Ministry of Science, has created scientific foundations for the sustainable development of Austrian landscapes and regions (plus bordering regions). Landscapes and regions were to be explored from different angles; implementing the research findings was to be part of the research work. The programme was designed to make room for science open to society, for unconventional ideas, methods, and courses of action. Programmatic targets and research principles supported this intent. The results of the programme met with national and international approval. The ALR knowledge balance is an attempt at presenting and assessing the achievements of this comprehensive contract research programme.

Le programme du Ministère autrichien des Sciences, intitulé « Recherche sur le paysage autrichien », visait à construire les fondements scientifiques d'un développement durable des paysages et des régions de l'Autriche et des territoires limitrophes. Les paysages et les régions ont été étudiés selon différentes approches disciplinaires et la mise en pratique des résultats de cette étude était partie prenante du programme de recherche. La vocation de ce programme était de faire la place à une science ouverte sur la société, à des idées, méthodes et pratiques non conventionnelles. Les objectifs du programme et les principes de recherche vont dans le sens de ces exigences. Les résultats du programme ont été reconnus sur le plan national et international. Le bilan des connaissances du programme de recherche sur le paysage autrichien (KLF) a pour but de présenter et d'évaluer les performances de ce vaste programme de recherche.

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Mots-clés: politique de la recherche, bilan des connaissances, interdisciplinarité, transdisciplinarité, développement durable
Keywords: research policy, knowledgebalance, interdisciplinarity, transdisciplinarity, sustainability

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